

# PYRETHRUM AND ITS CULTIVATION IN INDIA

Dr. AKHTAR HUSAIN



CENTRAL INDIAN MEDICINAL PLANTS  
ORGANISATION  
NATIONAL BOTANIC GARDENS CAMPUS  
LUCKNOW, INDIA







**COMMUNITY HEALTH CELL**

**Mark's Road, Bangalore - 560**

**FARM BULLETIN NO. 4**

**PYRETHRUM AND ITS CULTIVATION  
IN INDIA**

**DR. AKHTAR HUSAIN**

**COMMUNITY HEALTH CELL**

**326, V Main, I Block**

**Koramangala**

**Bangalore-560034**

**India**



**CENTRAL INDIAN MEDICINAL PLANTS ORGANISATION  
NATIONAL BOTANIC GARDENS CAMPUS  
LUCKNOW, INDIA**

508

AGR 115.

COMMUNITY HEALTH CELL  
47/1, (First Floor) St. Marks Road,  
Bangalore - 560 001.

1977

Printed at Leipzig Press, NDSE Part-I, New Delhi-49



## CONTENTS

	<i>Page</i>
Introduction	1
Botany	3
Soil and Climate	4
Cultivation	5
Fertiliser Application	7
Interculture	7
Irrigation	8
Harvesting and Drying	8
Yield of Flowers and Pyrethrin Content	8
Uses of Pyrethrum	9
Economics of Cultivation of Pyrethrum	11





# PYRETHRUM AND ITS CULTIVATION IN INDIA

## INTRODUCTION

The term Pyrethrum is now applied to dried flower-heads of *Chrysanthemum cinerariaefolium* Vis. (Fam. *Compositae*). Flowers are the source of pyrethrins, which are the most useful insecticides for control of household insects and protection of food grains.

Pyrethrum is cultivated on commercial scale in Algeria, Dalmatia (Yugoslavia), Brazil, Bulgaria, Japan, Kenya, Russia, New Guinea, Congo, Tanzania, Equador and India. At present Kenya, Congo, Tanzania and New Guinea are the chief producers and the rest of the countries produce only small amounts for their domestic use. In 1971-72 the world's total production of Pyrethrum was 21,780 tonnes, of which Kenya, Tanzania, Equador and Rwanda produced 20,800 tonnes, while the rest was produced by other countries.

The use of Pyrethrum for insecticidal preparations appears to have originated in Persia near about 400 B.C. It was considered a secret, and the species used were *C. roseum* Adam and *C. coronarium* Linn. with very poor pyrethrin content. Many workers have reported that Pyrethrum powder was introduced into Eastern Europe early in the nineteenth century by an American merchant, who discovered the secret about this preparation during his travels in Caucasus. According to another version, the secret was revealed to Russians by some war-prisoners. The actual date of recognition of its insecticidal activity is not definite, but it is certain that *C. cinerariaefolium*



was being produced in Dalmatia and it rapidly superseded the Persian species in Europe. The story about the detection of the insecticidal property of Pyrethrum is itself very interesting. A German woman of Dubrovnik in Dalmatia is said to have picked a bouquet of flowers of *C. cinerariaefolium* for decoration in a room. She threw them in a corner after they withered and after several weeks she found the withered flowers surrounded by dead insects. She associated the death of insects with the insect-killing properties of the flowers, and started the centre for manufacturing Pyrethrum powder.

The actual date of discovery of insecticidal activity is not certain but Pyrethrum was used as an insecticide in Europe more than a century ago and in Persia considerably earlier. It was imported into USA as "insect powder" as early as in 1860.

Dalmatia was the main producing area in the earlier stages. However, Japan became the chief producer after 1914. Production of Pyrethrum in Japan increased to 12,000 tonnes in 1935. Japan remained the main supplier of Pyrethrum until World War II when all supplies from Japan were cut off, and Kenya and other African countries took over the production. Pyrethrum was introduced into Kenya in 1928 and between 1935 and 1941 Kenya altogether replaced the Japanese Pyrethrum in the world. At present, Kenya and neighbouring countries of Tanzania and Rwanda produce over 80% of the total Pyrethrum produced in the world (Table 1).

**Table 1 : World Production of Pyrethrum During 1971-72**

Country	Production in tonnes
Kenya	14,400
Tanzania	4,300
Equador	1,100
Rwanda	1,000
Japan	380
Others	600
Total	21,780



The first attempt to introduce Pyrethrum in India was made by the Forest Department, Jammu and Kashmir State, as early as in 1931. As the initial experiments were promising, commercial production was taken up in an area of 130 ha. The area was progressively increased to 790 ha. in 1945 with an annual production of about 80 tonnes. During the period 1951-52, five more farms with a total area of 430 ha. were established by the Drug Research Laboratory of the State Government for cultivation of Pyrethrum as the main crop, producing about 100 tonnes of flowers. These farms were closed down in 1962-63, and the plantations of the Forest Department also deteriorated with the result that, at present, the total Pyrethrum plantation of J & K was reduced to approximately 320 ha. with an annual production of about 25 tonnes.

On the basis of the recommendations of the Malaria Control Department of the Ministry of Health, Pyrethrum production was also started in Nilgiri Hills and Palni Hills of Tamil Nadu during World War II and the area rose to 750 ha. during 1944-47 with a maximum production of about 50 tonnes of flowers. However, the production was given up because of failure of the Malaria Control Department to purchase the flowers in 1947-48. At present, there is hardly any Pyrethrum plantation in the Nilgiris.

#### BOTANY

*C. cinerariaefolium* Vis. ( $2n=18$ ) is a glaucous perennial herb up to 60 cm. high. The stems are unbranched with few short scattered hairs below the flower. The leaves are long petioled, finely cut and silky beneath with distant segments. The plant bears numerous flower-heads which measure 6-9 mm. when closed, and 9-12 mm., when open. The involucre consists of two to three mm. of yellowish or greenish yellow, lanceolate hair bracts. Each flower-head bears a receptacle 4 to 8 mm. in diameter. The receptacle is nearly flat and bears numerous yellow disc-florets and a single row of cream-coloured ligulate ray-florets, 12 mm. in length with 3 rounded teeth. The cream-coloured floret looks like that of field daisy (*C. leucanthemum* Linn.) but differs from the latter in having the central teeth of ray-floret shorter than the adjacent ones.





*Chrysanthemum cinerariaefolium*

A, leaf; B, a twig; C, capitulum; D, ray-floret; E, disc-floret

#### SOIL AND CLIMATE

Pyrethrum grows best in fertile deep- and well-drained soils. The yields are considerably lower in poorly drained soils. Light and medium loam soils, derived from volcanic rocks with good water-holding capacity, are ideal for the crop.

Although Pyrethrum is a native of temperate zone and for a long time it has been confined to temperate areas of Europe, it grows best in areas which have a mild cool climate with a short mild winter and cool summer. A period of chilling, in which the temperature falls below 17°C, for about six weeks is necessary for flower-bud initiation. In temperate climates, like that of Europe or Kashmir Valley in India where winters are long (November to March) and summers are warm, there is only one flush of flowering in May and June. The yield in this climate is lower in contrast to the highlands of Kenya where there is



only minor change of temperature during the year with the maximum temperature of about 21°C. In Kenya three flushes of flowers are obtained because of three periods of flower-bud initiation during the year.

From the studies carried out it has been seen that hills near the Equator are ideal for Pyrethrum production. Kenya has the ideal conditions for obtaining maximum yields from these areas where the mean minimum temperatures do not fall below 10°C and mean maximum temperature does not go above 24°C. The quantum as well as distribution of rainfall during the year is another important factor which affects both the flower yield and the Pyrethrin content. Pyrethrum would grow well in all areas where total annual rainfall averages about 1000 mm. or more. It should be well distributed throughout the year. An average rainfall of about 100 mm. per month is ideal for growth and flowering. Very high rainfall accompanied by persistent clouds is highly unsuitable for Pyrethrum cultivation, as shade reduces the yield considerably. Areas with long period of mist, fog or frost are also unsuitable for cultivation of this plant. Bright sunshine with intermittent rainfall is the ideal. Short periods of drought are essential for interculture, weed control and harvesting of flowers.

Kashmir Valley and Himachal Pradesh in North and Nilgiri and Palni Hills in South are the only suitable places for cultivation of this crop.

The Nilgiri and Palni Hills, which have a climate more or less similar to Kenya, are much better for Pyrethrum cultivation as the yield obtained here is 2-3 times more than that in temperate areas in Kashmir or Himachal Pradesh.

## CULTIVATION

*Preparation of Field* : The field should be tilled enough to give a fine seed-bed. Generally, 2 to 3 harrowings followed by planking should give a good seed-bed. All weed and stubbles should be removed. It is better to make ridges 45-50 cm. apart if the land is flat. In case of undulating land, the area should be terraced.



Pyrethrum Plantation at Manasbal

*Raising the Nursery :* Pyrethrum is generally propagated by seeds. However, in certain conditions the crop can also be raised vegetatively by splits.

Nurseries are raised during spring (April-May) or autumn (October-November). In areas where irrigation is available, nursery can be raised any time from March to November. It is better to make seed-beds which are 15 to 18 cm. in height. Well-rotten farmyard or poultry manure is added in the top 10 cm. of the soil. The seeds are sown in rows 10 cm. apart, and covered with a layer of rice-straw, wheat-straw or dried grass. The beds are watered frequently. The seeds would germinate in 5-10 days depending upon the temperature during the sowing period. After the seeds are sprouted, the mulch is removed. In areas near the Equator, like Nilgiris, it is better to provide partial shade during the early phase of growth of the seedlings specially during the months when sunlight is maximum. In



temperate areas <sup>India</sup> shading is required. The seed-beds should be kept free from weeds by frequent hand weeding. The seedlings are ready for planting, after 8-12 weeks. The ideal time of planting is spring (March-April) or autumn (October-November). However, the seedlings can be planted during any time of the year, if irrigation facility is available.

In case of vegetative propagation, healthy plants are pulled up from the ground, splits of which are planted similar to seedlings. In certain areas it is better to plant the splits first in a nursery before planting in the field. The seedlings are planted at a distance of 30-45 cm. in rows 45-50 cm. apart. Ridge planting is always better than flat planting as it facilitates inter-culture and irrigation and avoids waterlogging.

#### FERTILISER APPLICATION

In rich soils Pyrethrum can be grown without fertilisers. However, in areas like Kashmir Valley, fertiliser application is necessary to obtain good growth. It has been found that 40 kg./ha. of nitrogen, 50 kg./ha. of phosphorus and 50 kg./ha. of potash is optimum for good growth of Pyrethrum in the first year. All the phosphorus and potash should be applied as a basal dose at the time of planting, while 50% of nitrogen should be applied as basal dose and the rest in split doses.

In certain areas like Kenya, nitrogen has not been found to give any response but phosphate has been found to be essential for good flower yield. In Japan all the three fertilisers have been found beneficial for good crop yield. The fertiliser application should be repeated every year. Phosphate and potash are generally applied in spring at the time of first harvesting, while nitrogen is applied in two split doses in the months of March and April, respectively.

#### INTERCULTURE

Pyrethrum requires clean cultivation, and proper weeding and hoeing are necessary to obtain good yield. Both hoeing and weeding can be done by a tractor-drawn cultivator, and hand-hoes can be used in small terraces. The first hoeing can

be done in autumn after the last crop is harvested, which should be followed by two weedings and hoeing in spring.

### IRRIGATION

Pyrethrum does not require any irrigation if the rainfall is well distributed. However, in areas like Kashmir, Pyrethrum crop requires irrigation during dry months to get quick growth of crop. Unirrigated crop takes 3 years for optimum yield. Good flower yield can be obtained after one year if the crop is irrigated frequently during the dry months of June, July and August. It is always better to irrigate after fertiliser application.

### HARVESTING AND DRYING

In areas like Kenya and the Nilgiris in India, three harvests of flowers are obtained as the flowering in these areas continues for 9 months. The crop gives poor yield during the first year and the optimum yields are obtained only during 2nd and 3rd year. In temperate areas like Kashmir, the first harvest is obtained in the end of June or 1st week of July. Flowers should be picked when 2/3rd of the disc-florets are open and the ray-florets are horizontal. Harvesting of immature or over-mature flowers decreases their pyrethrin content.

The flowers should be dried immediately after picking. In India the flowers are dried in sun in thin layers. These should be turned frequently in order to avoid fermentation. The ideal method of drying is to dry the flowers in hot-air driers. However, the temperature of drier should not exceed 80°C. It is safer to dry in sun where the acreage is small and there is no chance of rain during the harvesting season. However, in larger farms use of air-driers is essential in order to dry the harvested flowers in time.

### YIELD OF FLOWERS AND PYRETHRIN CONTENT

The average annual yield of Pyrethrum is about 250 kg/ha. in Kashmir whereas the average annual yield in the Nilgiris is about 500 kg/ha. Pyrethrum flowers grown in Kashmir have average pyrethrin content of 1 per cent, while those grown in the Nilgiris have pyrethrin content of 1.5 per cent.



## USES OF PYRETHRUM

Pyrethrum is cultivated for its insecticidal properties. Active principles, though present in all parts of plants, are mainly concentrated in the developing seeds or the achenes. These active constituents consist of 3 pairs of esters: Pyrethrin I, Cinerin I, Jasmolin I, Pyrethrin II, Cinerin II, and Jasmolin II, and are collectively referred as Pyrethrins. Pyrethrins are extracted in the form of concentrated oleoresins by a number of petroleum solvents, including petroleum ether and ethylene dichloride. The concentrated extract, used as such or after refining, is used in a number of insecticide formulations.

Pyrethrum is the best insecticide possessing a number of useful properties not found in any other single insecticide. Its main characteristics is the quick knock-down effect on a number of insects. It is a contact insecticide and acts promptly on central nervous system of the insect causing paralysis and subsequent death.

The most valuable property of Pyrethrum in comparison to other insecticides is its very low mammalian toxicity and because of this quality, Pyrethrum is the only safe insecticide to be used where synthetic insecticides pose a problem of health hazards for human beings, domestic animals and wildlife. Pyrethrins easily degenerate in presence of sunlight and do not suffer from the defects generally associated with persistent insecticides which have high residual toxicity. In addition to their direct toxic action, pyrethrins have powerful repellent activity which makes them ideal insecticide for a number of insects.

Pyrethrum is the only insecticide against which insect species do not develop the resistance very easily. Large scale development of strains of insect-pests against pyrethrins has not been reported, except in isolated cases. It is also one of the few insecticides which has broad-spectrum activity against a very wide range of insect species.

Pyrethrum is used as an insecticide in a number of ways, in the form of powder, sprays, aerosol, coils, cream and ointment.

*Powder* : The flowers finely ground and mixed with some insect-carriers are used as an insecticide to control a large number of insects. These are specially useful in eradicating cockroaches, crickets, silverfish, ant, lice and insects found in kitchen, food stores and refuse dumps. Pyrethrum powder can also be used to protect stored food grains against insect pests. For this purpose, Pyrethrum powder along with some inert carrier is mixed with food grain in sacks or tins and the grain can safely be used for food.

*Liquid Sprays* : Both oil-based as well as water-based sprays are being used. In oil-based sprays Pyrethrum oleoresin or refined extract is diluted with certain petroleum products, such as kerosene and small amount of synergist. Water-based sprays contain Pyrethrum extract, synergist an emulsifier and a solvent like commercial xylene. These sprays are used in factories, hospitals and food grain stores. These are also used as live-stock sprays for control of parasitic insects like ticks, mites, flies and midges.

*Aerosols* : These are very fine droplets of Pyrethrins which remain suspended in the air for long periods. Flying insects passing through the suspended droplets accumulate lethal doses of Pyrethrins and are killed. Aerosol often referred as bombs, consists of a metal container with a release mechanism filled with a propellant mixture of Feron-11 and Feron-12 along with refined Pyrethrum extract in colourless kerosene or water-based emulsion. Aerosols are very effective for control of flying insects like flies and mosquitoes and according to international civil aviation regulations only Pyrethrum aerosols can be used for disinfestation of passenger aircrafts.

*Coils* : Pyrethrum smoke produced from smouldering coils or sticks has proved very effective against mosquitoes, midges and other household insects. The coils are made from finely ground Pyrethrum powder, an organic filler and a binder. Japan and Hong Kong are the main producers of Pyrethrum coils. It is considered to be the cheapest methods to control mosquitoes in humid tropics.



*Ointments and Creams* : The ointments and creams are mostly used for control of parasitic insects in veterinary. Their main ingredients are Pyrethrum extract , a synergist, wax, lactic acid, glycerine or sorbitol. Recently Pyrethrum extract incorporated in vanishing creams has found use as a mosquito repellent in Asian countries.

Recently Pyrethrum has been used for protection of dried fish and fish meal against flies. It has also been used in tomato-canning industry against fruit flies and in mushroom houses for control of insect pests of common mushroom (*Agaricus bisporus*).

## ECONOMICS OF CULTIVATION OF PYRETHRUM

Amount in Rs.

*Cost during the 1st year (per ha.)*

1. Preparation of field	200
2. Raising nursery	200
3. Planting seedlings in the field	200
4. Irrigation (No irrigation required in Tamil Nadu Hills)	300
5. Weeding and interculture	200
6. Fertiliser and fertiliser application	300
7. Harvesting, drying and packing	200

(It will be more in Tamil Nadu Hills)

Rs. 1,600/-



## Economics of Cultivation of Pyrethrum—contd.

*Cost during the succeeding four years (per ha.)*

	Amount in Rs.
1. Cost of weeding and interculture	300
2. Cost of irrigation	100
3. Cost of fertiliser and fertiliser application	300
4. Cost of harvesting, drying and packing	300
Total cost	Rs. 1,000/-

Total cost for five years ( $1000 \times 4 = 4000 + 1600$ ) Rs. 5,600/-

Cost per hectare per year ( $5600/5$ ) Rs. 1,120/-

Rent of land and interest on capital Rs. 80/-

Total Rs. 1,200/-

### *Yield of Pyrethrum flowers in Kashmir and other North-Indian Hills :*

First year	100 kg./ha.
Succeeding years	250 kg./ha.
Total for 5 years	1100 kg./ha.
Yield per year/ha.	220 kg.

Cost of flowers @ Rs. 10/- per kg Rs. 2,200/-

Profit per ha./year in Kashmir Rs. 1,000/-

### *Yield in Tamil Nadu Hills :*

During the 1st year	200 kg./ha.
During succeeding years	500 kg./ha.
Total in five years	2200 kg./ha.
Yield per ha./year	440 kg./ha.

Cost of flowers @ Rs. 12/kg.

(Due to higher Pyrethrin content) Rs. 5,280/-

Profit ( $5280 - 1200$ ) Rs. 4,080/-

**COMMUNITY HEALTH CELL**  
**326, V Main, 1 Block**  
**Koramangla**  
**Bangalore - 600034**  
**India**





